**HIGH SCHOOL**

**Biotechnology**

**Supplemental: Biology with Technology**

**Goal:** Understanding what biotechnology is and how its use changes the way medicines work.

**Materials: (for a class of 30)**

* Carton of yogurt
* Loaf of bread
* Picture of pure bred dog
* Copies of human graph students sheet
* Copies of Biotechnology timeline

**Time:** 45 – 60 minute class period

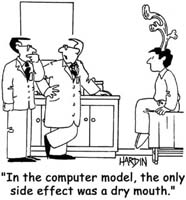
**National Science Standards:** S1, S5, S6, S7

**Prep:**

Set up agree, undecided and disagree signs in three of the four corners of your classroom.

**Procedure:**

* Write a definition of Biotechnology on the board.
  + “Biotechnology is [technology](http://en.wikipedia.org/wiki/Technology) based on [biology](http://en.wikipedia.org/wiki/Biology), especially when used in [agriculture](http://en.wikipedia.org/wiki/Agriculture), [food science](http://en.wikipedia.org/wiki/Food_science), and [medicine](http://en.wikipedia.org/wiki/Medicine). Biotechnology is the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services.”
* Show the biotechnology cartoons on the overhead.
* Have each student complete the Human Graph Student Sheet.
* Designate different parts of the classroom as agree, undecided and disagree.
* Choose a statement from the Human Graph Student Sheet and have a student read the statement aloud.
* Students should go to the area in the classroom that best expresses their feelings on the issue.
* Have students explain their rationale.
* Ask if any students would like to move after hearing the explanations.
* Choose another statement from the Human Graph Student Sheet.
* Have students go to the area in the classroom that expresses the opposite of their true feelings.
* Repeat the same process as above. – You may want to revisit this exercise after completing the What’s up with Gena?” module.
* Explain that some of those questions make biotechnology sound very complex but in fact it is branch of science that has been around for a very long time.
* Place the yogurt, bread and picture of a pure bred dog in front of the students. Ask them to brainstorm what these three things have to do with biotechnology.
* Hand out the Biotechnology timeline students sheets.
* Review the sheet with the students. Ask them when they think biotechnology became a very important scientific discipline. *(this should be when DNA was discovered.)*
* Review that prior to this discovery, biotechnology was primarily to do with agriculture.
* Explain to the students that still remains to be a very exciting area of biotechnology today but they are going to study medical and pharmaceutical biotechnology.
* Ask students to brainstorm a list of medicines that they or someone they know have taken in their lives. Record student answers on the board.
* Ask the students if any of the medicines use biological material.
* What might be the benefits of using biological materials to make treatments? What might be the drawbacks?
* For homework ask the students to research one drug that uses biotechnology to treat people.









**Human Graph Student Sheet**

|  |  |  |
| --- | --- | --- |
| **agree** | **undecided** | **disagree** |

1. Animals should be cross-bred in order to make animals that are more desirable to people such as the “Labradoodle”.

A U D

2. Crops should be genetically modified if it means that they could provide food for starving people.

A U D

3. Parents should be allowed to choose the sex of their baby if science can make it possible.

A U D

4. Embryonic stem cells should be used for research and medical treatments of chronically ill patients.

A U D

5. Biotechnology should be funded by our government

A U D

6. Genetic testing should be mandatory even if there is no treatment for the disease which the person might have.

A U D

7. Strict regulations should be made by the government to restrict manipulation of DNA in plants and animals.

A U D

8. Animals should not be used to test new biotechnology methods.

A U D

9. Using biotechnology treatments is better for the environment because harmful chemicals are not being produced.

A U D

**Timeline of Biotechnology**

*(Excerpts from Wikipedia)*

Notable events in the [history of biotechnology](http://en.wikipedia.org/wiki/History_of_biotechnology):

* **before** [**8000 BC**](http://en.wikipedia.org/wiki/8000_BC) – Collecting of [seeds](http://en.wikipedia.org/wiki/Seed) for replanting. Evidence that [Mesopotamian](http://en.wikipedia.org/wiki/Mesopotamia) people used [selective breeding](http://en.wikipedia.org/wiki/Selective_breeding) ([artificial selection](http://en.wikipedia.org/wiki/Artificial_selection)) practices to improve [livestock](http://en.wikipedia.org/wiki/Livestock).
* **around** [**7000 BC**](http://en.wikipedia.org/wiki/7000_BC) – Brewing [beer](http://en.wikipedia.org/wiki/Beer), [fermenting](http://en.wikipedia.org/wiki/Fermentation_%28food%29) [wine](http://en.wikipedia.org/wiki/Wine), baking [bread](http://en.wikipedia.org/wiki/Bread) with help of [yeast](http://en.wikipedia.org/wiki/Yeast).
* [**8000 BC**](http://en.wikipedia.org/wiki/8000_BC) - [3000 BC](http://en.wikipedia.org/wiki/3000_BC) – [Yogurt](http://en.wikipedia.org/wiki/Yoghurt) and [cheese](http://en.wikipedia.org/wiki/Cheese) made with [lactic-acid-producing](http://en.wikipedia.org/wiki/Lactic_acid) bacteria by various cultures.
* [**1590**](http://en.wikipedia.org/wiki/1590) **AD** – The [microscope](http://en.wikipedia.org/wiki/Microscope) is invented by [Zacharias Janssen](http://en.wikipedia.org/wiki/Zacharias_Janssen).
* [**1675**](http://en.wikipedia.org/wiki/1675) **AD** – Microorganisms discovered by [Anton van Leeuwenhoek](http://en.wikipedia.org/wiki/Anton_van_Leeuwenhoek).
* [**1856**](http://en.wikipedia.org/wiki/1856) **AD** – [Gregor Mendel](http://en.wikipedia.org/wiki/Gregor_Mendel) discovered the [laws of inheritance](http://en.wikipedia.org/wiki/Laws_of_inheritance).
* [**1862**](http://en.wikipedia.org/wiki/1862) **AD** – [Louis Pasteur](http://en.wikipedia.org/wiki/Louis_Pasteur) discover the [bacterial](http://en.wikipedia.org/wiki/Bacteria) origin of [fermentation](http://en.wikipedia.org/wiki/Fermentation_%28biochemistry%29).
* [**1919**](http://en.wikipedia.org/wiki/1919) **AD** – [Karl Ereky](http://en.wikipedia.org/w/index.php?title=Karl_Ereky&action=edit), a Hungarian agricultural engineer, first used the word biotechnology.
* [**1928**](http://en.wikipedia.org/wiki/1928) **AD** – [Alexander Fleming](http://en.wikipedia.org/wiki/Alexander_Fleming) noticed that a certain [mold](http://en.wikipedia.org/wiki/Mold), could stop the development of bacterias, leading to the first [antibiotic](http://en.wikipedia.org/wiki/Antibiotic), [penicillin](http://en.wikipedia.org/wiki/Penicillin).
* [**1953**](http://en.wikipedia.org/wiki/1953) **AD** – [James D. Watson](http://en.wikipedia.org/wiki/James_D._Watson) and [Francis Crick](http://en.wikipedia.org/wiki/Francis_Crick) describe the structure of [deoxyribonucleic acid](http://en.wikipedia.org/wiki/Deoxyribonucleic_acid), called DNA for short.
* [**1972**](http://en.wikipedia.org/wiki/1972) **AD** – The DNA composition of [chimpanzees](http://en.wikipedia.org/wiki/Chimpanzee) and [gorillas](http://en.wikipedia.org/wiki/Gorilla) is discovered to be 99% similar to that of humans.
* [**1975**](http://en.wikipedia.org/wiki/1975) **AD** – Method for producing [monoclonal antibody](http://en.wikipedia.org/wiki/Monoclonal_antibody) developed by Kohler and Milstein.
* [**1980**](http://en.wikipedia.org/wiki/1980) **AD** – Modern biotech is characterized by [recombinant DNA technology](http://en.wikipedia.org/wiki/Recombinant_DNA_technology). The [prokaryote](http://en.wikipedia.org/wiki/Prokaryote) model, [E. coli](http://en.wikipedia.org/wiki/E._coli), is used to produce [insulin](http://en.wikipedia.org/wiki/Insulin) and other medicine, in human form. (About 5% of diabetics are allergic to animal insulins available before).

The United States Supreme Court, in [447 U.S. 303](http://en.wikipedia.org/wiki/447_U.S._303) ([1980](http://en.wikipedia.org/wiki/1980)), rules in favor of microbiologist [Ananda Chakrabarty](http://en.wikipedia.org/wiki/Ananda_Chakrabarty) in the case of a [USPTO](http://en.wikipedia.org/wiki/USPTO) request for a first patent granted to a [genetically modified](http://en.wikipedia.org/wiki/Genetically_modified) living organism (GMO) in history.

* [**1984**](http://en.wikipedia.org/wiki/1984) **AD** – [Nutrigenomics](http://en.wikipedia.org/wiki/Nutrigenomics) as applied science in animal nutrition.
* [**1994**](http://en.wikipedia.org/wiki/1994) **AD** – U.S. [FDA](http://en.wikipedia.org/wiki/FDA) approves of the first GM food: the "[Flavr Savr](http://en.wikipedia.org/wiki/Flavr_Savr" \o "Flavr Savr)" tomato.
* [**1997**](http://en.wikipedia.org/wiki/1997) **AD** – British scientists, led by [Ian Wilmut](http://en.wikipedia.org/wiki/Ian_Wilmut), from the [Roslin Institute](http://en.wikipedia.org/wiki/Roslin_Institute) report cloning a sheep called [Dolly the sheep](http://en.wikipedia.org/wiki/Dolly_the_sheep) using DNA from two adult sheep cells.
* [**2000**](http://en.wikipedia.org/wiki/2000) **AD** – Completion of a, "rough draft," of the human [genome](http://en.wikipedia.org/wiki/Genome) in the [Human Genome Project](http://en.wikipedia.org/wiki/Human_Genome_Project).
* [**2002**](http://en.wikipedia.org/wiki/2002) **AD** – Researchers sequence the DNA of [rice](http://en.wikipedia.org/wiki/Rice), the main food source for two-thirds of the world's population. Rice is the first crop to have its genome decoded.
* [**2003**](http://en.wikipedia.org/wiki/2003) **AD** – [GloFish](http://en.wikipedia.org/wiki/GloFish), the first biotech pet, hits the North American market. Specially bred to detect water pollutants, the fish glows red under black light thanks to the addition of a natural [bioluminescence](http://en.wikipedia.org/wiki/Bioluminescence) gene.